**PLATE TECTONICS**

LAB REPORT – 90 pts.

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Group #: \_\_\_\_\_\_\_\_

Period: \_\_\_\_\_\_\_\_

**OBJECTIVE:** To identify various plate boundaries and faults and relate it to plate tectonics.

**QUESTION:** How can we represent layers of Earth’s interior using a saltwater solution?

**HYPOTHESIS:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(1 pt.)**

**MATERIALS:**

* 4 test tubes
* Test tube rack with smaller test tubes
* Food coloring
* Clear plastic straw
* Glass jar
* Salt
* Scissors
* Colored pencils
* Plastic spoon
* Funnel
* Pen
* Metric ruler
* Glue
* Map cutouts
* Fault cutouts
* Stirring rod
* Tape
* Compass
* Calculator
* 1 lab report sheet per student

**INTRODUCTION:**

A German scientist by the name of **Alfred Wegener**, emerged with a hypothesis as to why certain continents seemed to fit together like the pieces of a jigsaw puzzle. This was known as **continental drift** and there were several forms of evidence to support this notion including fossils of ancient animals like the **Mesosaurus**, and fossils of ancient ferns like the **Glossopteris**. Wegener never received the recognition due to him until after his death when a group of scientists set out to explore the Mid-Atlantic Ridge in 1947. They discovered it was part of a chain of underwater mountains known as **mid-ocean ridges**. This led a geologist by the name of **Harry Hess** to propose a theory where new oceanic lithosphere is formed when magma rises to the surface through rifts as solidifies. This process is now known as **sea-floor spreading**.

**PROCEDURE:**

1. Four test tubes should be in the back slots of your test tube rack. Fill them 2/3 of the way with WARM water from your lab station sink.
2. Place ONE drop of green food coloring in the test tube furthest to the left. Stir the test tube to spread the color throughout the solution. Eventually, this will represent the core of the Earth.
3. Place ONE drop of red food coloring in the test tube directly right of the green one. Stir the solution once again. Eventually, this will represent the mantle of the Earth.
4. Place ONE drop of yellow food coloring in the test tube directly right of the red one. Stir the solution once again. Eventually, this will represent the outer core of the Earth.
5. Place ONE drop of blue food coloring in the test tube directly right of the yellow one. Stir the solution once again. Eventually, this will represent the inner core of the Earth. It is very important you align the test tubes in this particular order on your test tube rack in order.
6. Using your pen, mark the straw with a line every 2 cm. Continue to do this for 8 cm.

1. Add 1/4 spoonful of salt to the red solution. Stir this solution with your stirring rod for 2-3 minutes making sure the salt is dissolved within the solution. Place your test tube back in its designated location on the test tube rack.
2. Add 1/2 spoonful of salt to the yellow solution. Stir this solution with your stirring rod for 2-3 minutes making sure the salt is dissolved within the solution. Place your test tube back in its designated location on the test tube rack.
3. Add 1 level spoonful of salt to the blue solution. Stir this solution with your stirring rod for 2-3 minutes making sure the salt is dissolved within the solution. Place your test tube back in its designated location on the test tube rack. Don’t worry, the green solution was supposed to be water and food coloring only.
4. Place the straw into the green solution up to your first pen mark. Seal the straw with your fingertip and allow your lab partner(s) to draw what they see inside of the straw for Diagram 1.
5. Keep your straw sealed until you are ready to place it into the next solution (the red one). Release your finger when the straw makes contact with the red solution and fill it up to the second pen mark and re-seal the straw with your fingertip. Have your lab partner(s) draw what they see inside of the straw for Diagram 2.
6. Keep your straw sealed until you are ready to place it into the next solution (the yellow one). Release your finger when the straw makes contact with the yellow solution and fill it up to the third pen mark and re-seal the straw with your fingertip. Have your lab partner(s) draw what they see inside of the straw for Diagram 3.
7. Keep your straw sealed until you are ready to place it into the final solution (the blue one). Release your finger when the straw makes contact with the blue solution and fill it up to the fourth and final pen mark and re-seal the straw with your fingertip. Have your lab partner (s) draw what they see inside of the straw for Diagram 4.
8. Dump the solution in your straw down the drain in your lab station sink and have your lab partner(s) complete and repeat steps 10-13 in order for you to draw the diagrams this time.
9. Make sure all test tubes are thoroughly washed out and placed back on the test tube drying rack at your lab station. Properly dispose of the straw in the nearest garbage can.

**DIAGRAMS (4 pts.)** *– Draw the appropriate diagrams in color.*

**Diagram 1 Diagram 2 Diagram 3 Diagram 4**

1. Now, take out your map cutouts and color the area around the Plateosaurus PURPLE on the Europe and Asia landmass. Do this for the North American landmass as well.
2. Color the area around the Phytosaur RED on the Europe and Asia landmass. Do this for the North American and African landmasses as well.
3. Color the area containing the igneous rock, basalt, BLACK on the Europe and Asia landmass. Do this for the North American and African landmasses as well.
4. Color the desert region YELLOW on the North American landmass. Do this for the South American, African, and Antarctica land masses as well.
5. Color the area around the Rhynchosaur BLUE on the South American landmass. Do this for the African and Indian landmass as well.
6. Color the amphibian region GREEN on the South American landmass. Do this for the African, Indian, Antarctica, and Australian landmasses as well.
7. Cut out landmasses 1 through 7 very carefully. Using the legend page, try to piece all 7 landmasses together correctly according to objects and animal fossils they contain. Glue the landmasses in the globe beneath the legend. **(7 pts.)**
8. Now, you will be constructing fault replicas using paper models. Color each shaded area on the fault cutouts a different color. Do this for the normal, reverse, and strike-slip fault cutouts.
9. Carefully cut out each fault model: normal, reverse, and strike-slip. Fold the models along all gray lines and construct the appropriate faults by piecing them together by using tape.
10. Each model is worth 5 points and you must show the instructor your completed models. **(15 pts.)**

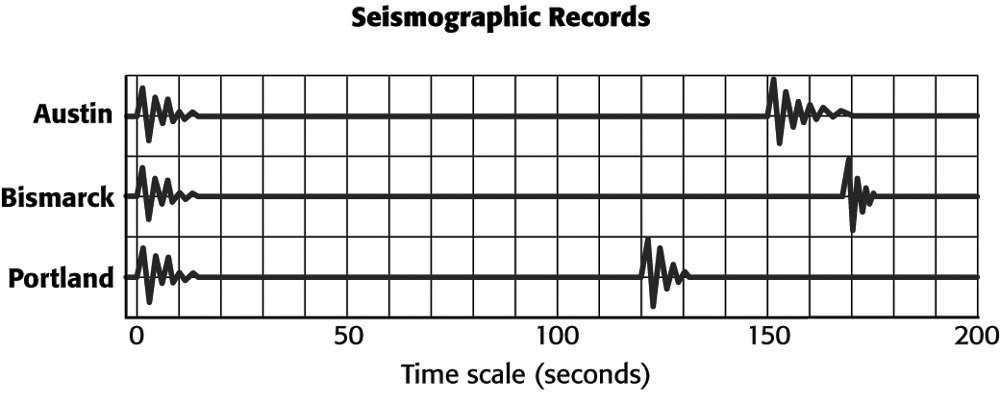
Type of Fault Grade *(Instructor Use Only)*

**Normal Fault** \_\_\_\_\_

**Reverse Fault** \_\_\_\_\_

**Strike-Slip Fault** \_\_\_\_\_

1. Study the diagram below showing seismographic records made in three cities following an earthquake. The traces begin at the left and show the arrival of P waves at time zero. The second set of waves on each record represents the arrival of S waves.



1. Use the time scale provided on the previous page to find the lag time between the P waves and S waves for each city. Remember, the lag time is the time between the moment the first P wave arrives and the moment the first S wave arrives. Be as accurate as possible and record all data in the data table on the next page under the lag time (seconds). **(3 pts.)**
2. Use the following equation to calculate how long it takes each wave to travel 100 km. Round answers to the nearest hundredth. **(2 pts.)**

**100 km.**

**time =**

**avg. speed of the wave (in Earth’s crust)**

P wave time: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

S wave time: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. To find lag time for earthquake waves at 100 km., subtract the time it takes P waves to travel 100 km. from the time it takes S waves to travel 100 km. Round to the nearest hundredth. **(1 pt.)**

Lag time for 100 km.: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Use the following formula to find the distance from each city to the epicenter. Record the data in the appropriate data table. Round to the nearest hundredth. **(3 pts.)**

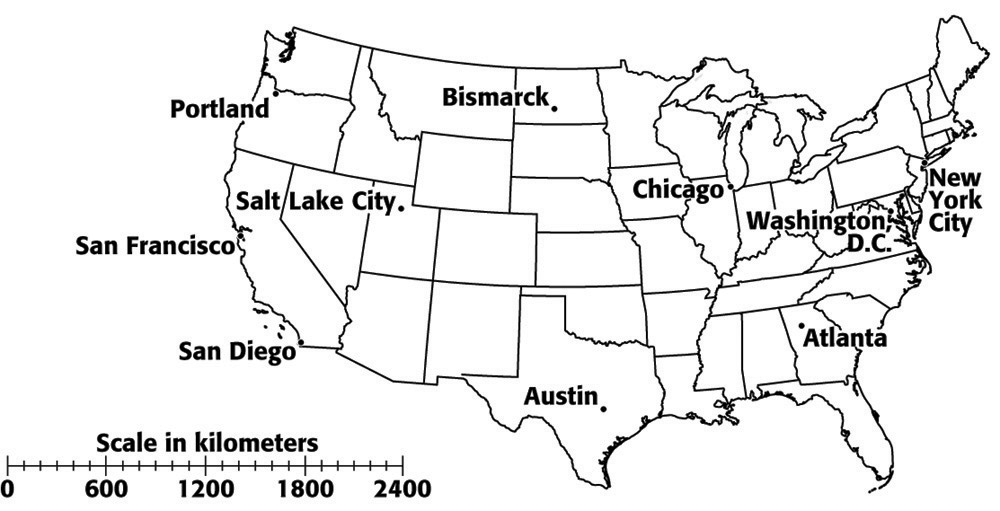
**measured lag time (s) x 100 km.**

**distance =**

**lag time for 100 km. (s)**

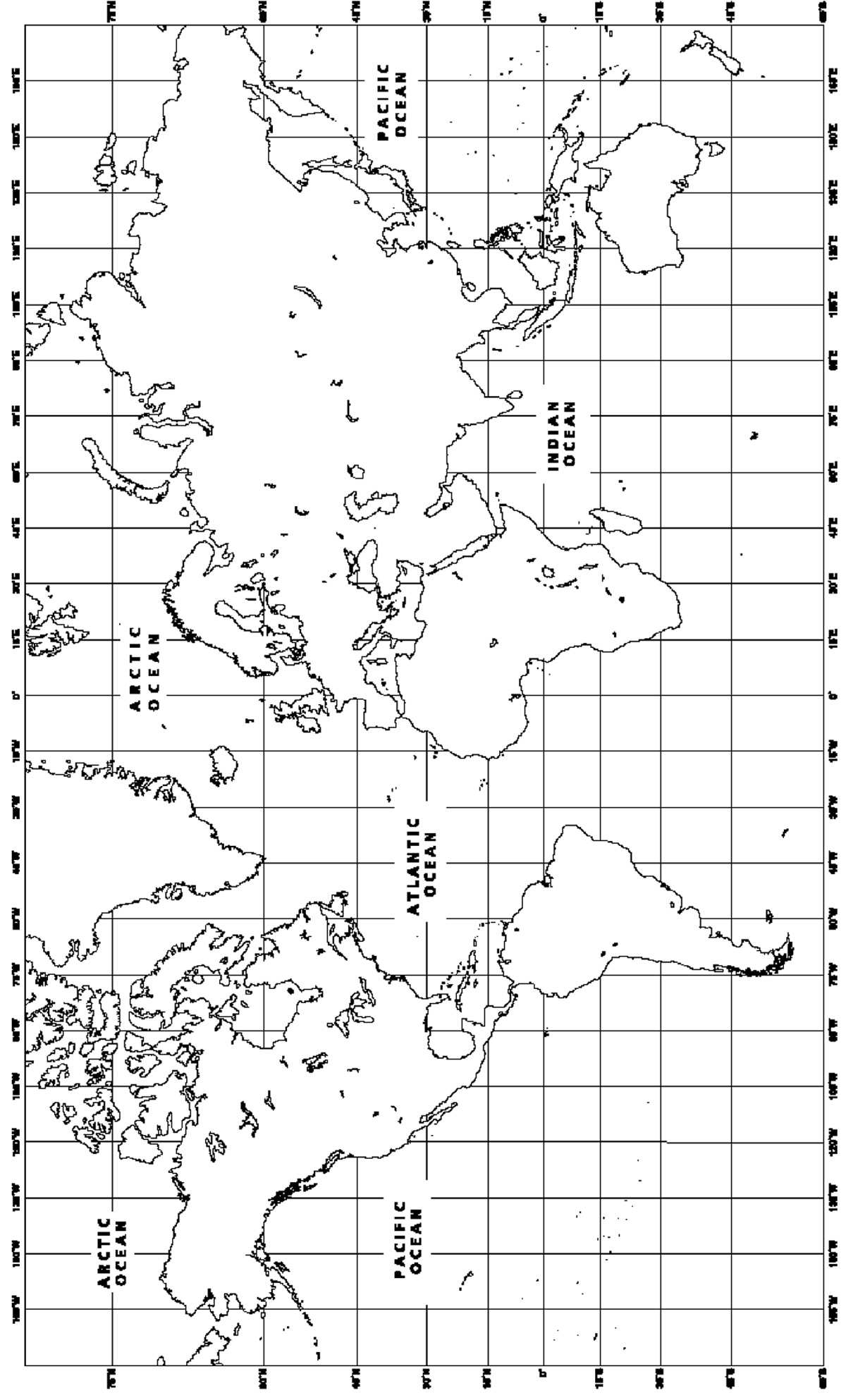
|  |  |  |
| --- | --- | --- |
| **City** | **Measured Lag time (seconds)** | **Distance to the epicenter (km)** |
| Austin, TX |  |  |
| Bismarck, ND |  |  |
| Portland, OR |  |  |

1. Look at the Earthquake Map of the United States below. Using the scale on the map, adjust your compass so the radius of a circle with Austin at the center is equal to the distance between Austin and the epicenter of the earthquake. Put the point of your compass at Austin on the map, and draw a circle. Repeat this process for Bismarck and Portland as well. **(3 pts.)**
2. The epicenter of the earthquake is located near the point where the three circles meet.

What city is this? **(1 pt.)** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Locate each volcano on the Volcano Map by using the Volcano Activity Chart. Draw a circle about 2mm. in diameter to represent each volcano on the map. Use the latitude and longitude grids to help you. The latitude and longitude measurements are in increments of 15°.
2. Review all volcanic eruptions from the Volcano Activity Chart. For each explosive eruption, color the circle red and label it with the name of the volcano. For each non-explosive eruption, color the circle yellow and label it with the name of the volcano. For volcanoes erupting in both ways, color the circle orange and label it with the name of the volcano. **(10 pts.)**

|  |  |  |
| --- | --- | --- |
| **Volcanic Activity Chart** | | |
| **Volcano name** | **Location** | **Description** |
| Mount St. Helens | 46°N 122°W | An explosive eruption blew the top off the mountain. Light-colored ash covered thousands of square kilometers. Another eruption sent a lava flow down the southeast side of the mountain. |
| Kilauea | 19°N 155°W | One small eruption sent a lava flow along 12km of highway. |
| Rabaul caldera | 4°S 152°E | Explosive eruptions have caused tsunamis and have left 1–2 m of ash on nearby buildings. |
| Popocatepetl | 19°N 98°W | During one explosion, Mexico City closed the airport for 14 hours because huge columns of ash made it too difficult for pilots to see. Eruptions from this volcano have also caused damaging avalanches from lava flows. |
| Soufriere Hills | 16°N 62°W | Small eruptions have sent lava flows down the hills. Other explosive eruptions have sent large columns of ash into the air. |
| Long Valley caldera | 37°N 119°W | Explosive eruptions have sent ash into the air. |
| Okmok | 53°N 168°W | Recently, there have been slow lava flows from this volcano. Twenty-five hundred years ago, ash and debris exploded from the top of this volcano. |
| Pavlov | 55°N 161°W | Eruption clouds have been sent 200 m above the summit. Eruptions have sent ash columns 10 km into the air. Occasionally, small eruptions have caused lava flows. |
| Fernandina | 42°N 12°E | Eruptions have ejected large blocks of rock from this volcano. |
| Mount Pinatubo | 15°N 120°E | Ash and debris from an explosive eruption destroyed homes, crops, and roads within 52,000 km2 around the volcano. |

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**LAB QUESTIONS (1 pt. each) –** *Please write your answers in* ***COMPLETE SENTENCES****!*

1. What did the different solutions inside of the straw represent?

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1. What layer of the Earth did the green solution, or top layer, represent?

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1. What layer of the Earth did the red solution, or middle layer, represent?

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1. What layer of the Earth did the yellow solution, or 1st part of the bottom layer, represent?

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1. What layer of the Earth did the blue solution, or 2nd part of the bottom layer, represent?

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1. What is the solid, central layer of the Earth with the densest elements? Name those elements.

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1. Why didn’t the solutions mix together once inside of the straw? How does this relate to Earth?

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1. Which part of the Earth contains the majority of its mass and volume?

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1. Who is the scientist behind the hypothesis of continental drift? Describe that hypothesis.

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1. Name the 15 major tectonic plates.

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1. Describe some supporting evidence for Wegener’s hypothesis of continental drift.

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1. What was the name of the supercontinent that existed approximately 300 million years ago?

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1. Explain the supercontinent cycle, starting 1 billion years ago going through 250 million years into the future.

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1. Define sea-floor spreading and explain the connection between it and mid-ocean ridges.

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1. Explain the evidence we find on Earth to prove magnetic reversals occur.

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1. Differentiate between normal polarity and reversed polarity.

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1. Describe the theory of plate tectonics.

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1. Differentiate between the three different types of plate boundaries.

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1. Define compression and identify along which plate boundary compression is most likely to occur.

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1. Define tension and identify along which plate boundary tension is most likely to occur.

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1. Define shear stress and identify along which plate boundary shear stress is most likely to occur.

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1. Define a fold and name the 3 different types.

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1. Explain the difference between a normal fault, a reverse fault, and a strike-slip fault.

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1. Describe an earthquake, noting how many major ones occur each year.

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1. Explain the study of earthquakes and the people who study them.

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1. Name the largest and most active zone of earthquake and volcanoes lying along the Pacific plate boundaries.

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1. Differentiate between the types of seismic waves resulting from earthquakes.

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1. What is the average speed of P waves in the crust? Of S waves in the crust?

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1. How are earthquakes located?

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1. What is the difference between the focus and the epicenter of an earthquake?

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1. Describe the different types of scales used to measure earthquakes.

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1. Differentiate between the different types of volcanic eruptions.

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1. Describe each type of volcano.

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1. Name the four types of lava, describing each one.

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1. How does a caldera form?

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**CONCLUSION (5 pts.) –** *Write a solid paragraph (at least 5 sentences) about your conclusions from the lab. Discuss the steps you went through during your lab experiment, what you accomplished, and how you tested your hypothesis. Also include what you learned as a result of this lab experiment.*

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